CCS Technical Documentation
RH-25 Series Transceivers

Troubleshooting - RF

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Transceiver Troubleshooting

The first thing to do when you are encountered with a problem is to carry out a thorough visual check of the module. Make sure that:

- there are no mechanical damages
- the solder joints are OK

Note: Before changing anything, ALL SUPPLY VOLTAGES AND THE SYSTEM CLOCK / SLEEP CLOCK should be checked.

Receiver Troubleshooting

General instructions for RX troubleshooting

Start the Phoenix software and use it to start the required RX-mode of the mobile phone. The troubleshooting flowchart is divided into three steps: (1) general checking, (2) local checking and (3) RX-chain checking.

Note: Before changing ASICs or Filters, all solderings and missing components must be checked visually. After any possible component changes, the phone must be tuned with the Phoenix autotune SW.

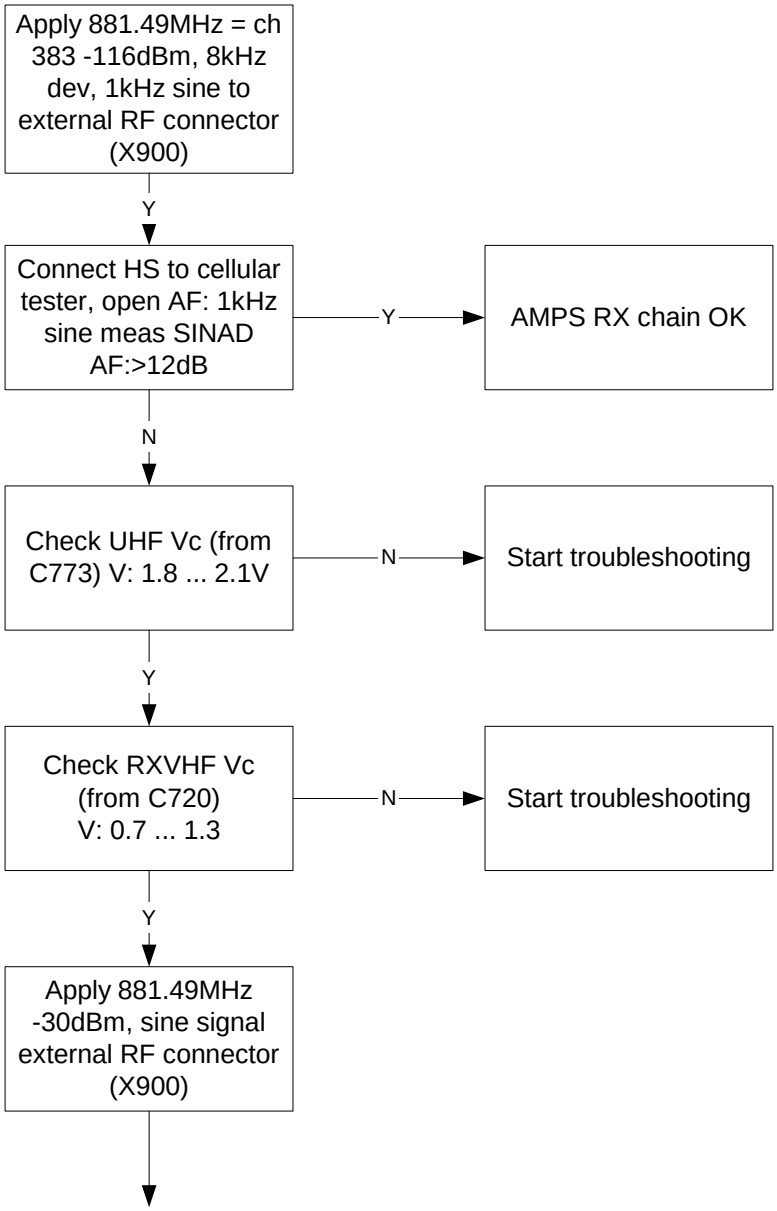
Path of the received signal

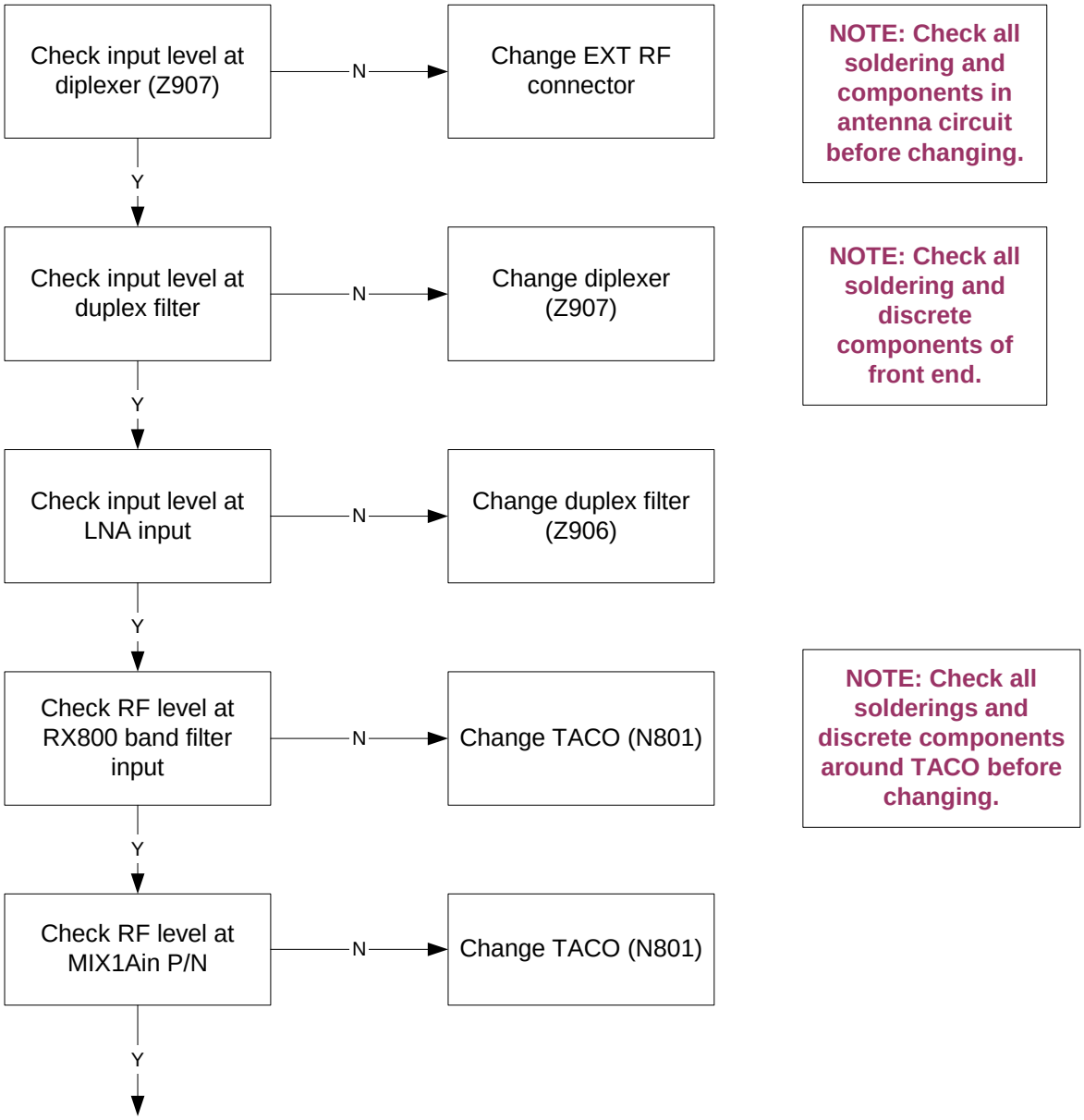
Block level description of the receiver:

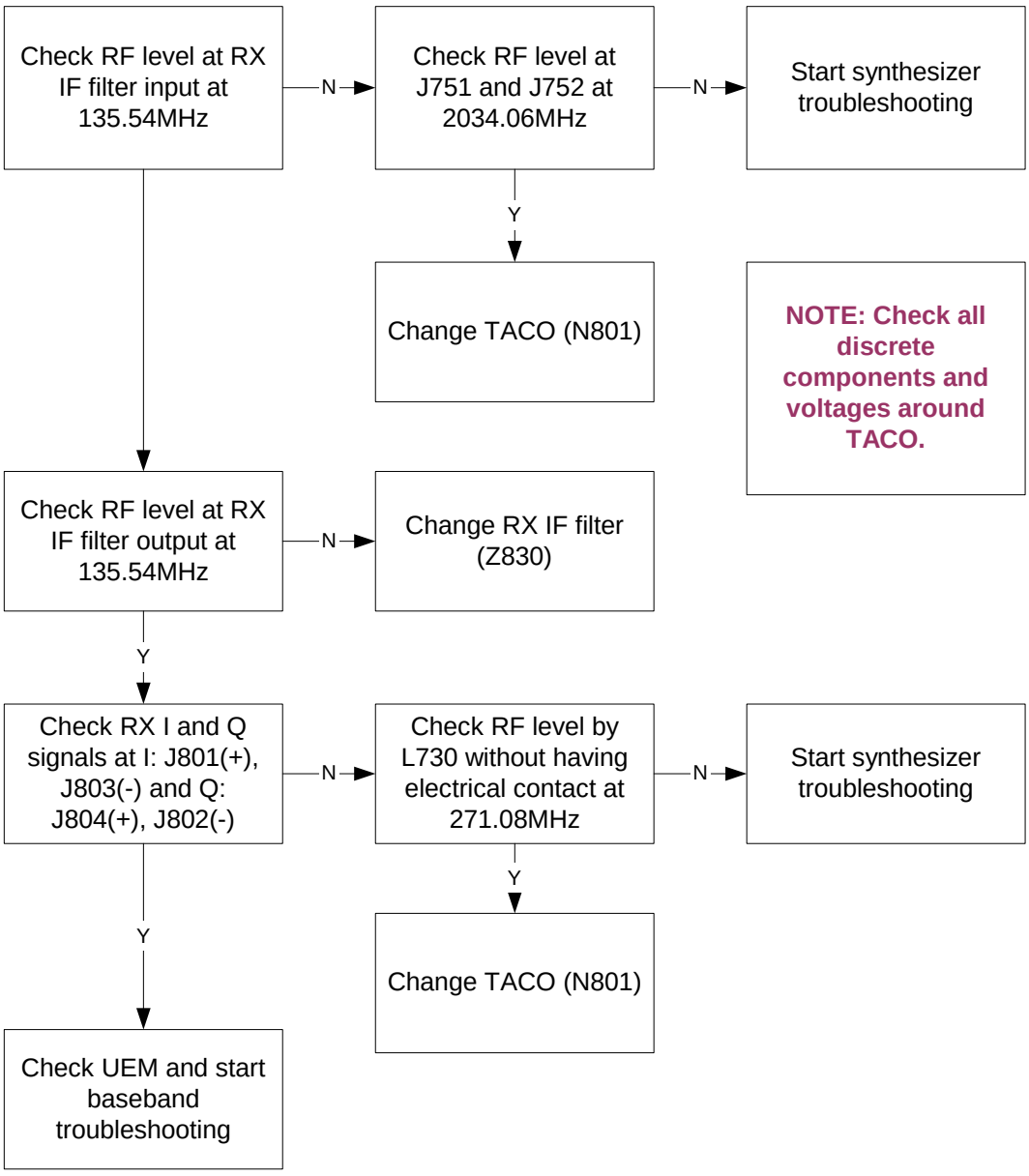
(Antenna/ext RF) – Diplexer – Duplexer – Low Noise Amplifier (LNA) – RX band filter – First mixer – 135.54 MHz RX IF filter – IF-amplifier – second mixer – 14 kHz low-pass filter – adjustable IQ amplifier – Baseband.

Fault finding charts for receiver chain

AMPS


Apply 881.49MHz = ch 383 -116dBm, 8kHz dev, 1kHz sine to external RF connector (X900)
Y
Connect HS to cellular tester, open AF: 1kHz sine meas SINAD AF:>12dB
Y
AMPS RX chain OK
N
Check UHF Vc (from C773) V: 1.8 ... 2.1V
N
Start troubleshooting
Y
Check RXVHF Vc (from C720) V: 0.7 ... 1.3
N
Start troubleshooting
Y
Apply 881.49MHz -30dBm, sine signal external RF connector (X900)


Check input level at diplexer (Z907)
N
Change EXT RF connector
Y
Check input level at duplex filter
N
Change diplexer (Z907)
Y
Check input level at LNA input
N
Change duplex filter (Z906)
Y
Check RF level at RX800 band filter input
N
Change TACO (N801)
Y
Check RF level at MIX1Ain P/N
N
Change TACO (N801)
Y
NOTE: Check all soldering and components in antenna circuit before changing.
NOTE: Check all soldering and discrete components of front end.
NOTE: Check all solderings and discrete components around TACO before changing.

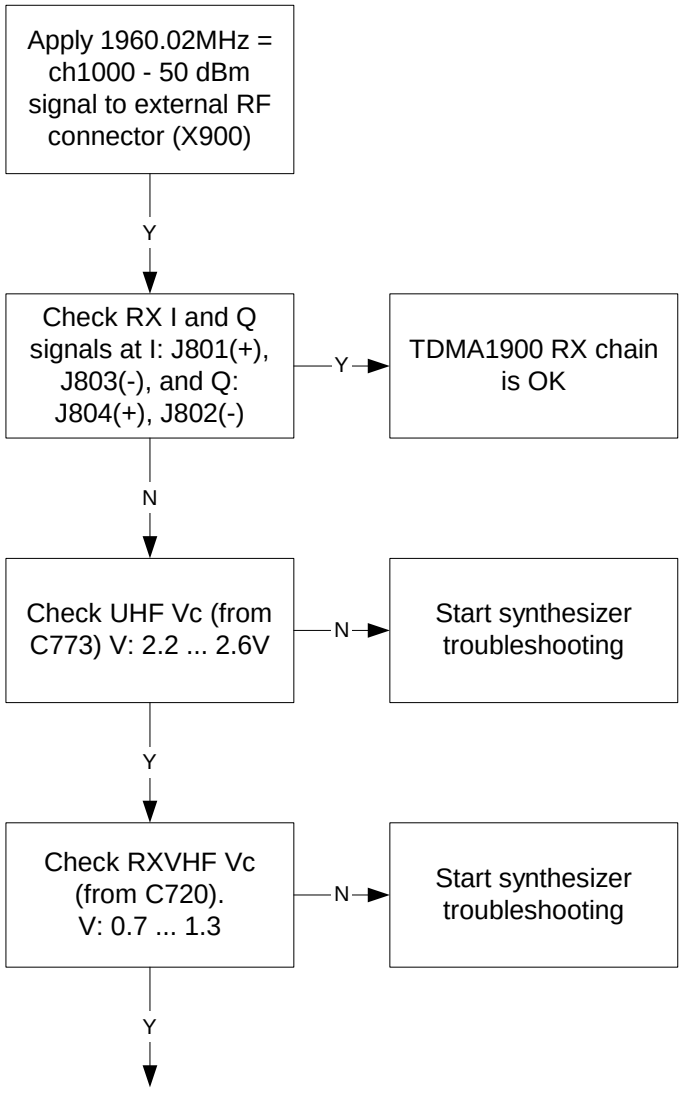

Check RF level at RX IF filter input at 135.54MHz
N
Check RF level at J751 and J752 at 2034.06MHz
N
Start synthesizer troubleshooting
Y
Change TACO (N801)
NOTE: Check all discrete components and voltages around TACO.
Check RF level at RX IF filter output at 135.54MHz
N
Change RX IF filter (Z830)
Y
Check RX I and Q signals at I: J801(+), J803(-) and Q: J804(+), J802(-)
N
Check RF level by L730 without having electrical contact at 271.08MHz
N
Start synthesizer troubleshooting
Y
Change TACO (N801)
Y
Check UEM and start baseband troubleshooting

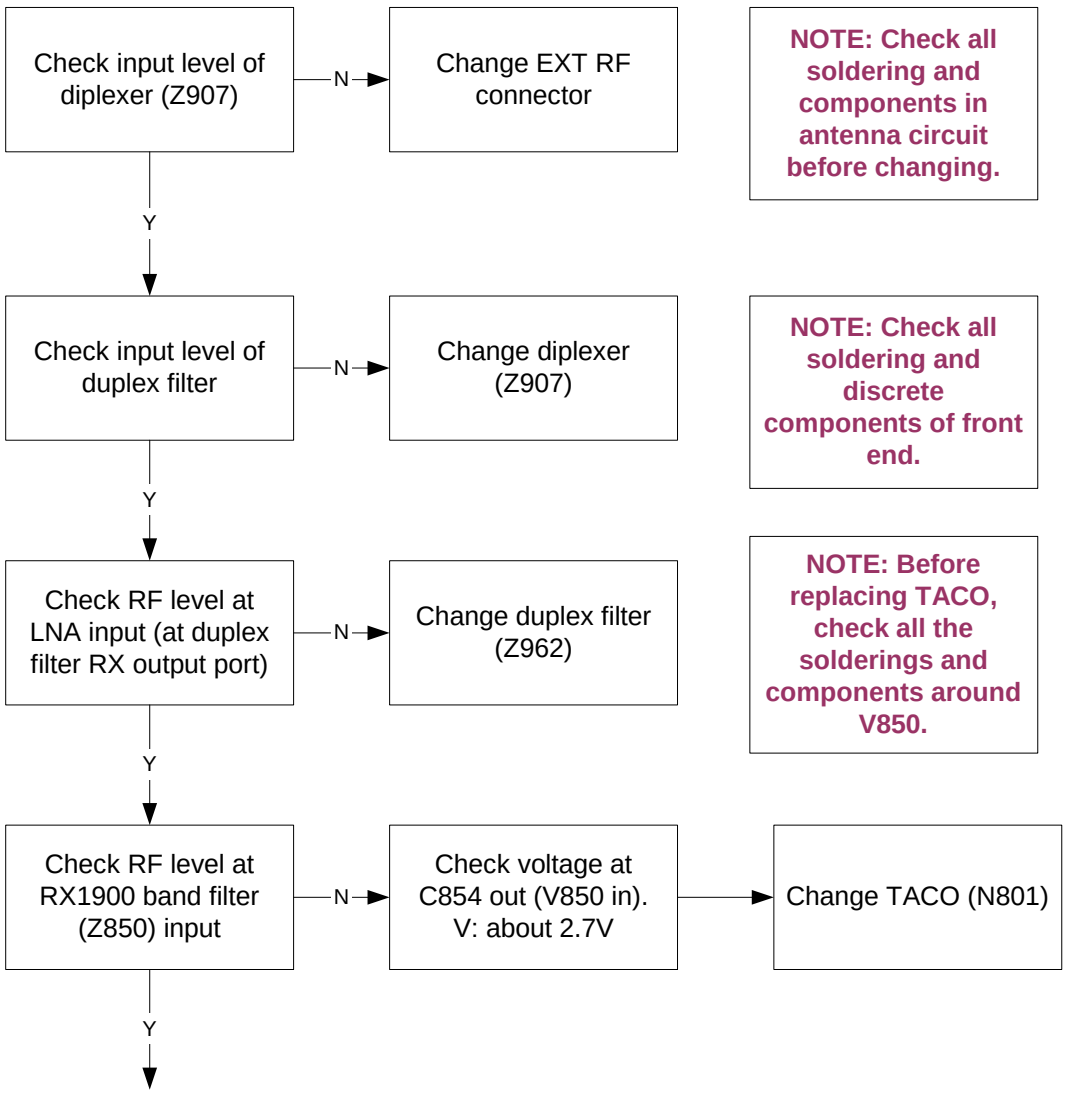
TDMA800

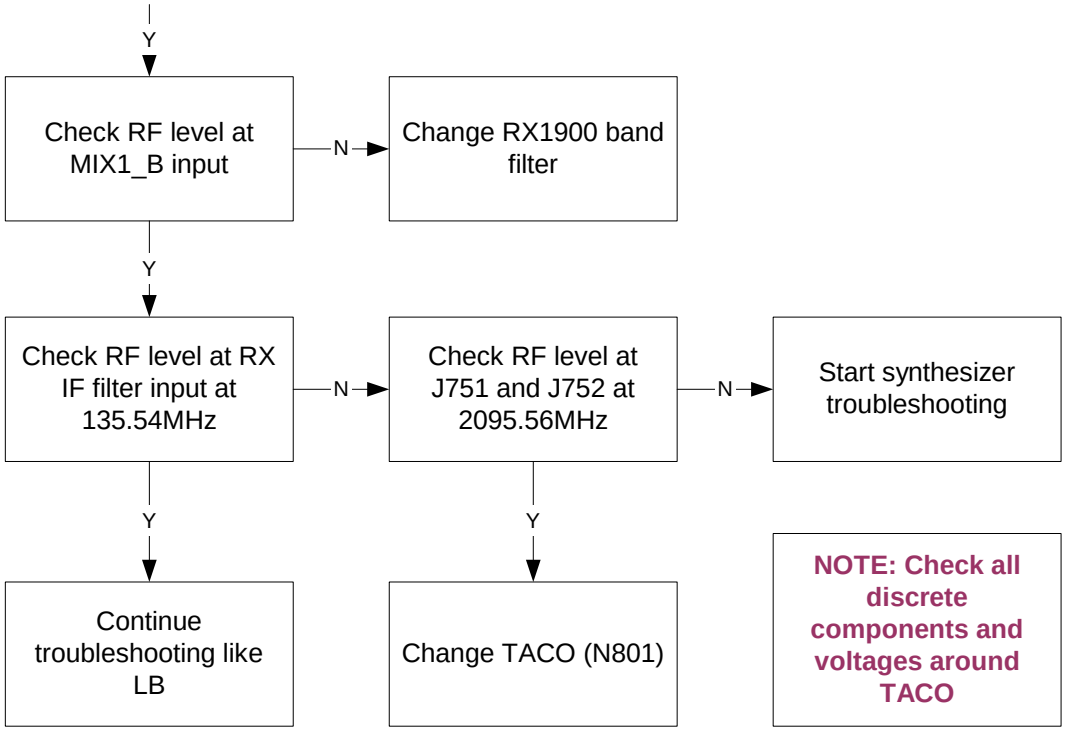
Since the same physical signal path is used for both analog and digital modes at the lower band, there is no need for additional troubleshooting in the digital mode. So if the digital mode at the lower band is not working properly, start the analog mode trouble-shooting.

TDMA1900 (only dualband)

Only EXT RF connector –> 1st IF needs separate troubleshoot at upper band. After down conversion (RF –> 135.54 MHz) both lower and upper band use same signal path.


Apply 1960.02MHz = ch1000 - 50 dBm signal to external RF connector (X900)
Y
Check RX I and Q signals at I: J801(+), J803(-), and Q: J804(+), J802(-)
Y
TDMA1900 RX chain is OK
N
Check UHF Vc (from C773) V: 2.2 ... 2.6V
N
Start synthesizer troubleshooting
Y
Check RXVHF Vc (from C720). V: 0.7 ... 1.3
N
Start synthesizer troubleshooting
Y


Check input level of diplexer (Z907)
N
Change EXT RF connector
NOTE: Check all soldering and components in antenna circuit before changing.
Y
Check input level of duplex filter
N
Change diplexer (Z907)
NOTE: Check all soldering and discrete components of front end.
Y
Check RF level at LNA input (at duplex filter RX output port)
N
Change duplex filter (Z962)
NOTE: Before replacing TACO, check all the solderings and components around V850.
Y
Check RF level at RX1900 band filter (Z850) input
N
Check voltage at C854 out (V850 in). V: about 2.7V
Change TACO (N801)
Y



Transmitter Troubleshooting

General instructions for TX troubleshooting

Always use an RF cable connected from an external RF connector to the analyzer via (rf-power) attenuator. This is important to protect the analyzer against excessive RF power and not to allow leakage of undesired RF power into the cellular frequencies.

1 Start the Phoenix-software and select the TX mode under *Testing* (AMPS, DAMPS, or TDMA 1900).

2 It is useful to select the mid channel (383 for AMPS/DAMPS or TDMA 1900) and power level 2.

Note: After any component change, tune the phone with the Phoenix autotune SW.

Path of the transmitted signal

AMPS/DAMPS

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (TACO) -> IF-BPF -> Upconverter+driver (TACO) -> Balun->BPF -> PA -> Coupler (Power detector) -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

TDMA1900 (ONLY DUALBAND)

UEM TX I/Q DA-converters -> I/Q modulator and Digital gain step amplifier (TACO) -> IF-BPF -> Upconverter+driver (TACO) -> Balun->BPF -> PA -> Coupler (Power detector) -> Duplex-filter -> Diplexer -> EXT RF-connector -> Antenna

Fault finding charts for the transmitter

AMPS

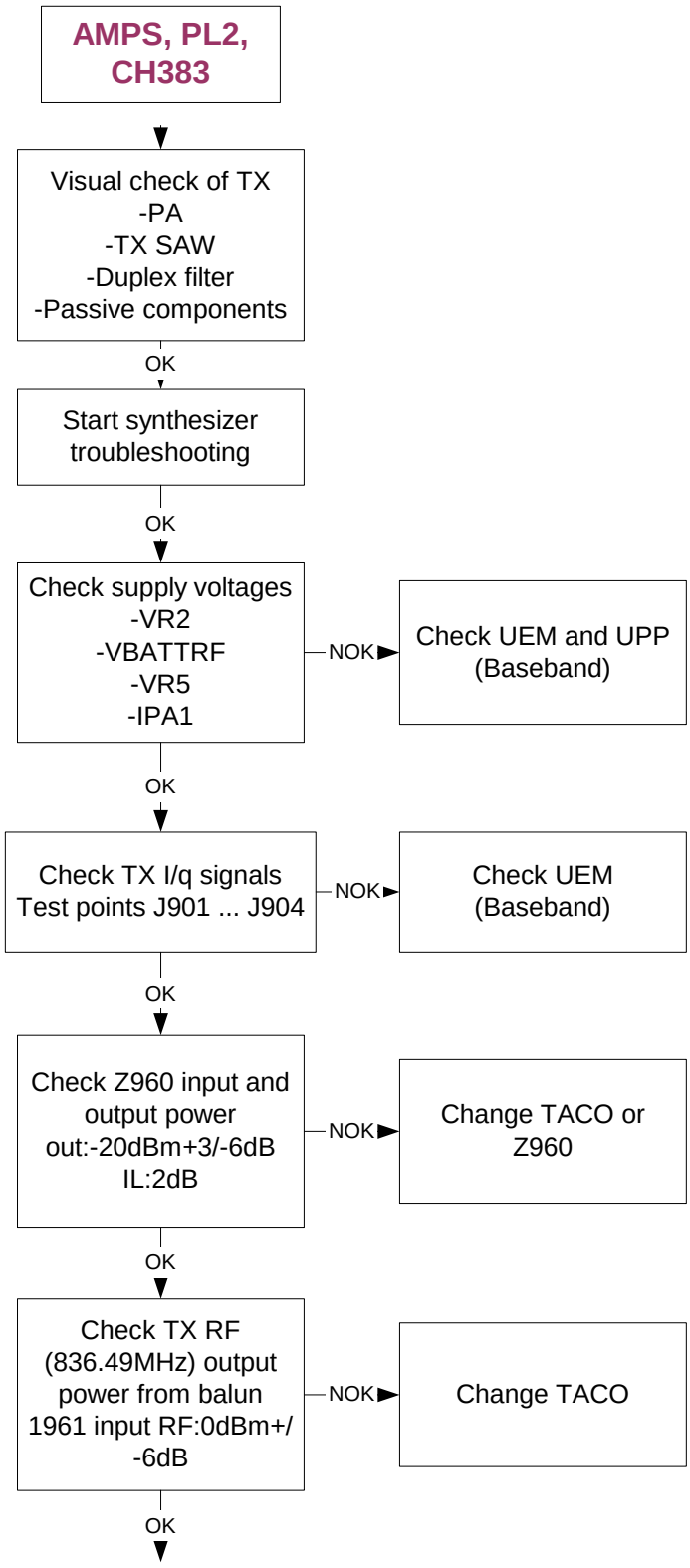
1 Start the Phoenix software and set the phone to analog mode by using RF Test UI.

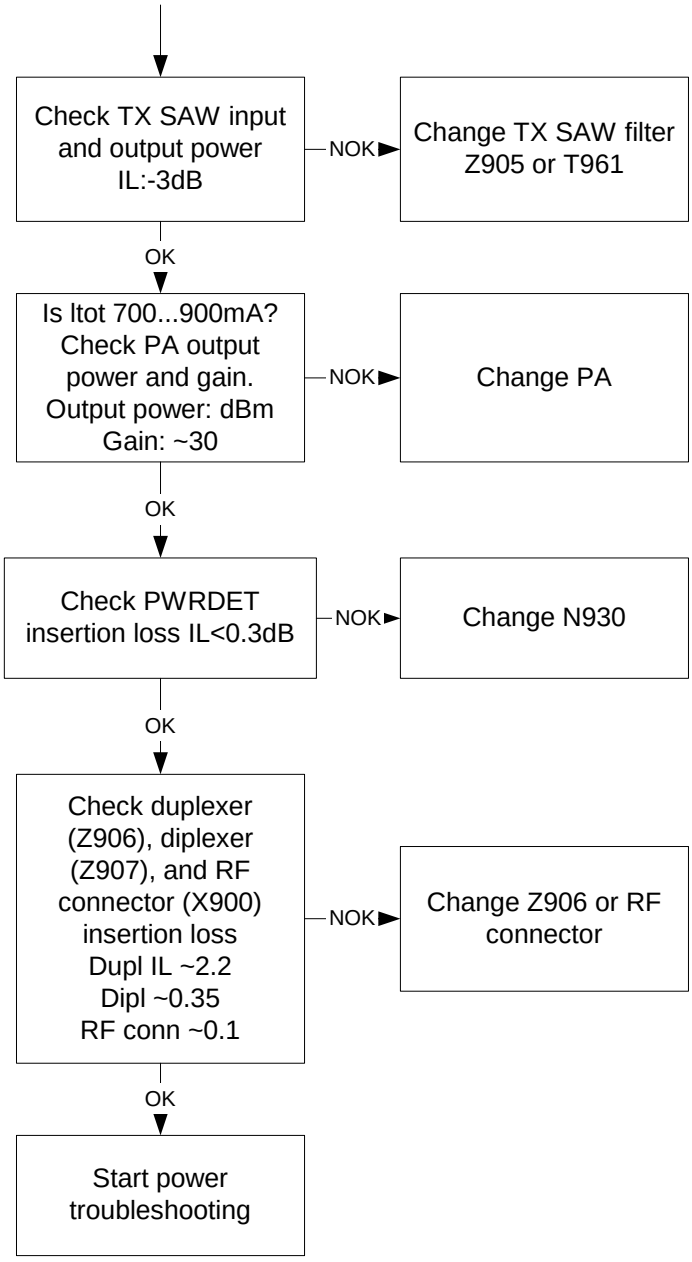
2 Set the channel to 383 and the power level to 2.

3 Connect the RF cable to the Ext RF connector.

4 Connect the cable to the Spectrum analyzer input.

5 Measure the RF level.


AMPS, PL2, CH383
Visual check of TX
-PA
-TX SAW
-Duplex filter
-Passive components
OK
Start synthesizer troubleshooting
OK
Check supply voltages
-VR2
-VBATTRF
-VR5
-IPA1
NOK
Check UEM and UPP (Baseband)
OK
Check TX I/q signals Test points J901 ... J904
NOK
Check UEM (Baseband)
OK
Check Z960 input and output power out:-20dBm+3/-6dB IL:2dB
NOK
Change TACO or Z960
OK
Check TX RF (836.49MHz) output power from balun 1961 input RF:0dBm+/-6dB
NOK
Change TACO
OK

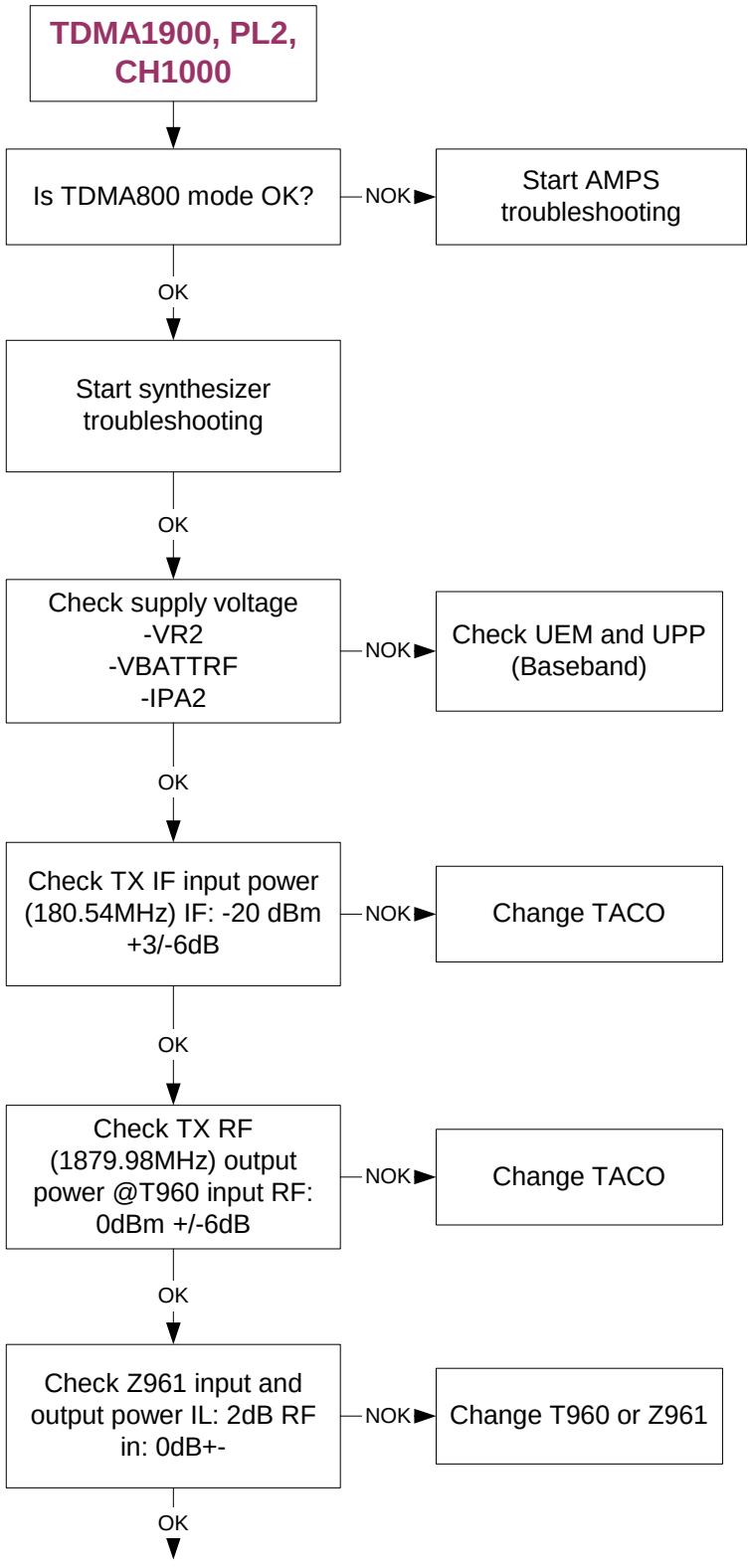

Check TX SAW input and output power IL:-3dB
NOK
Change TX SAW filter Z905 or T961
OK
Is Itot 700...900mA? Check PA output power and gain. Output power: dBm Gain: ~30
NOK
Change PA
OK
Check PWRDET insertion loss IL<0.3dB
NOK
Change N930
OK
Check duplexer (Z906), diplexer (Z907), and RF connector (X900) insertion loss Dupl IL ~2.2 Dipl ~0.35 RF conn ~0.1
NOK
Change Z906 or RF connector
OK
Start power troubleshooting

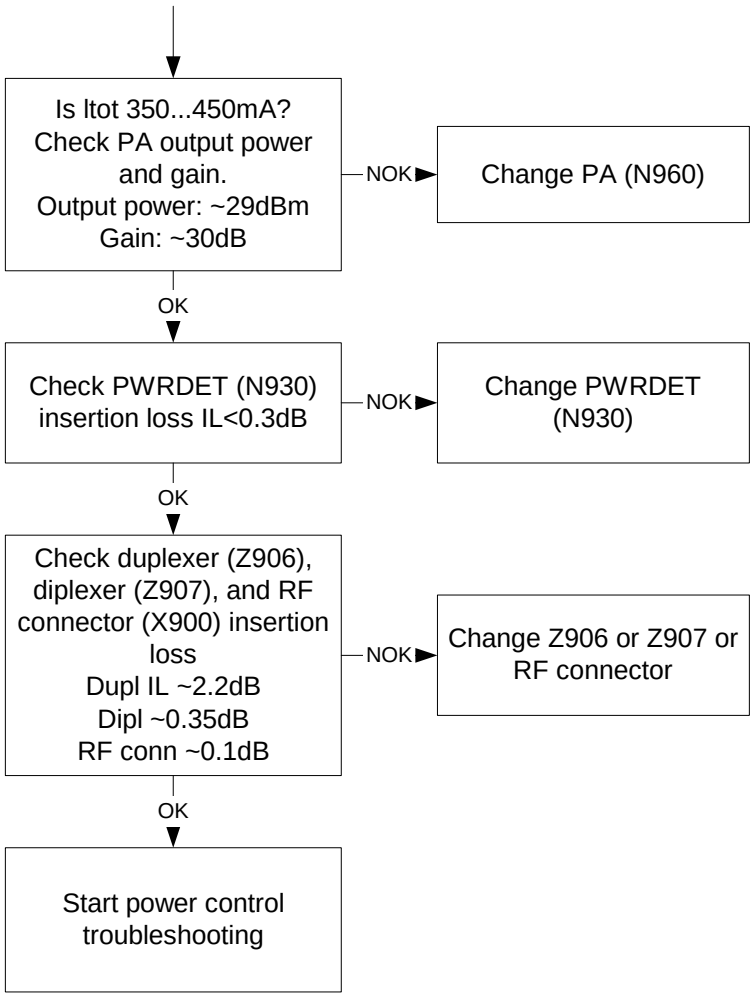
TDMA800

The transmitter chain is exactly the same as the AMPS mode, except for the IPA current, and thus it is important that the AMPS have no faults.

TDMA1900 (only dualband)

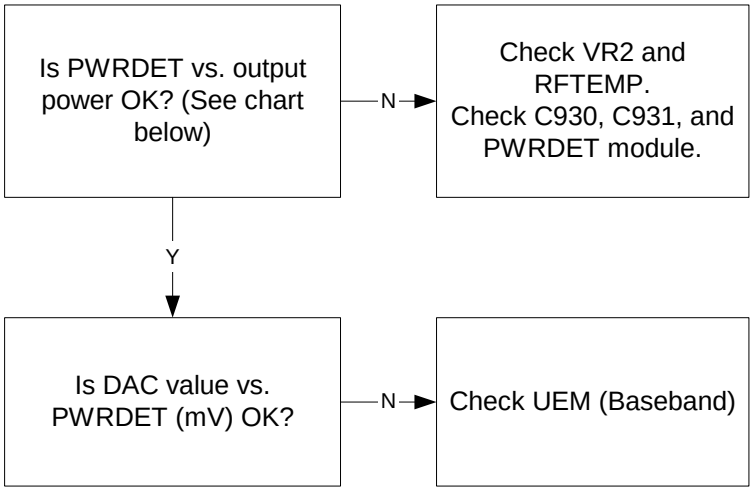
TDMA1900 mode and DAMPS mode have a common RF modulator.




Is Itot 350...450mA?
Check PA output power and gain.
Output power: ~29dBm
Gain: ~30dB
NOK
Change PA (N960)
OK
Check PWRDET (N930) insertion loss IL<0.3dB
NOK
Change PWRDET (N930)
OK
Check duplexer (Z906), diplexer (Z907), and RF connector (X900) insertion loss
Dupl IL ~2.2dB
Dipl ~0.35dB
RF conn ~0.1dB
NOK
Change Z906 or Z907 or RF connector
OK
Start power control troubleshooting

Power control loop

The power detection is done with the Power detector module and power control is done inside the TACO. Power detection is basically similar for both bands, except that both bands have their own coupler.


Is PWRDET vs. output power OK? (See chart below)
N
Check VR2 and RFTEMP. Check C930, C931, and PWRDET module.
Y
Is DAC value vs. PWRDET (mV) OK?
N
Check UEM (Baseband)

NOTE: See PWRDET vs. Output power curve

The detected voltages are illustrated in the following table and diagram:

Table 1: Typical detected voltages at power levels PL2...PL10 for dualband

800A				800D				1900D	
	Pout	TXPWRDET		Pout	TXPWRDET		Pout	TXPWRDET	
PL	dBm	dac	mV	dBm	dac	Mv	dBm	dac	mV
2	24.8	686	1932	27.3	779	2201	27.0	696	1956
3	22.0	512	1437	23.3	476	1312	23.3	431	1198
4	18.5	340	961	19.3	284	759	19.3	262	730
5	14.5	239	686	15.3	171	462	15.3	158	445
6	10.5	180	510	11.3	98	271	11.3	88	253
7	6.5	141	415	7.3	56	151	7.3	50	148
8	-	-	-	3.3	30	84	3.3	26	79
9	-	-	-	-0.7	14	46	-0.7	14	44
§0	-	-	-	-4.7	5	16	-4.7	6	20

Note: DAC values may vary about +- 20%.

Note: TXPWRDET is the difference between TX on burst and off burst.

Synthesizer Troubleshooting

There are four oscillators generating the needed frequencies for RF section. A 19.44 MHz VCTCXO is used as a reference signal oscillator, 2 GHz UHF VCO with loop filter circuit is used for RX and TX channel selection, TX VHF and RF VHF are for TX modulator and 2nd RX mixer locals generation.

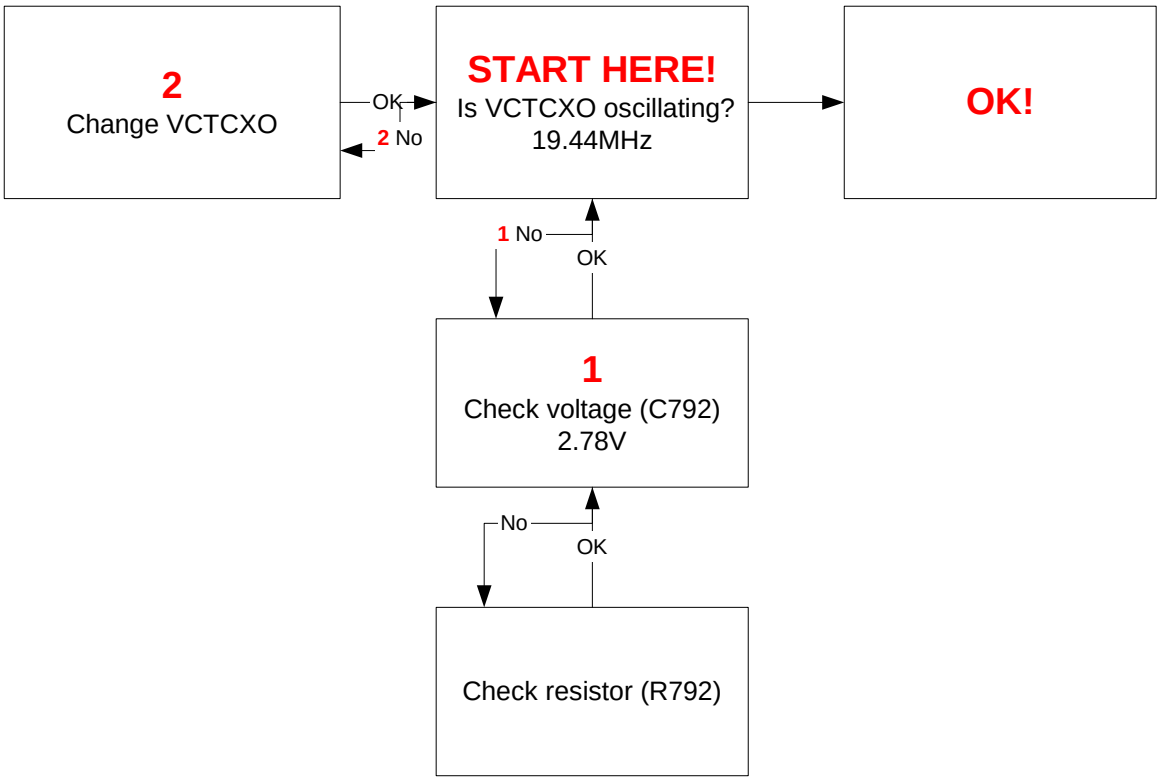
The VHF synthesizers are integrated in TACO, but have external VCO coils and loop filters. RX VHF frequency is fixed to 271.08 MHz and TX VHF is fixed to 361.08 MHz . All locals are locked to stable 19.44 MHz VCTCXO reference oscillator.

The frequency range for 2 GHz UHF VCO is: 2009.1 ... 2125.53 MHz. The output frequency range for the lower band is from 2009.16 to 2059.02 MHz. In upper band the output frequency range from the UHF VCO is from 2031.78 MHz to 2125.53 MHz.

It is a practical way to check out synthesizer status by measuring control voltage of the VCO from Integrator capacitor. If voltage is stable and reasonable, local oscillators are running correctly.

19.44 MHz reference oscillator

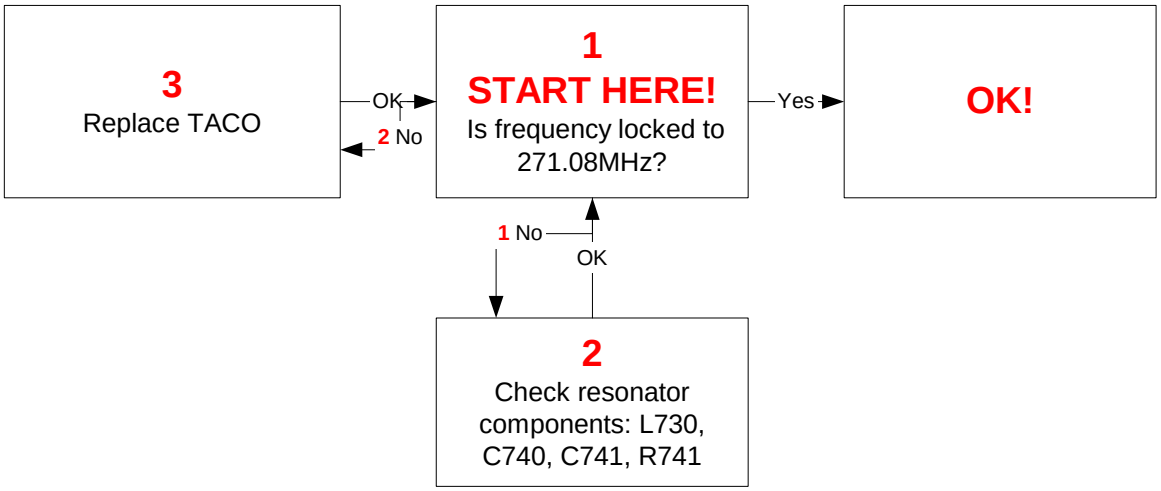
The VCTCXO oscillator frequency (G790) is controlled by UEM. This output 19.44 MHz signal is connected to TACO. It is used as a reference signal in TACO and also fed out as buffered clock signal to UPP. All synthesizers use divided 19.44 MHz signal as a reference signal for Phase locked loop to provide correct LO frequency.



RX VHF

The RX VHF signal is used to generate receiver Intermediate frequency. RX VHF has one fixed frequency (271.08 MHz). Operating frequency is locked in Phase locked loop.

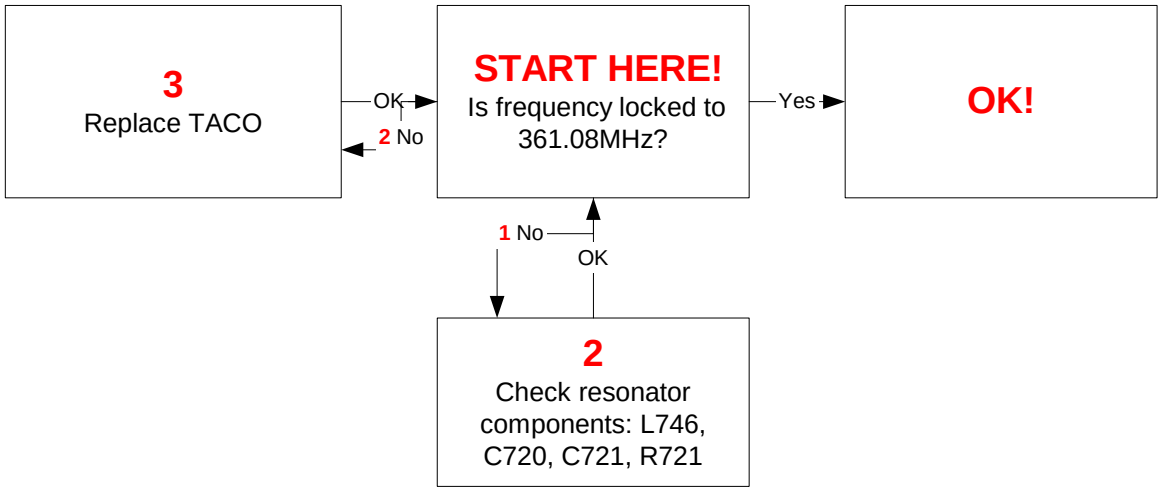
RX VHF PLL output signal is integrated in TACO. There are only four external components, VCO coil (L730) and loop filter components C740, C741, and R741.



TX VHF

The TX VHF signal is used to generate transmitter intermediate frequency. TX VHF VCO has one fixed frequency (361.08 MHz). Operating frequency is locked in phase locked loop. TX VHF VCO output signal is divided by 2 and fed to the modulator.

TX VHF is integrated in TACO. There are only four external components, VCO coil (L746) and loop filter components C720, C721, and R721.



UHF Synthesizer

The UHF VCO signal is used for RF channel selection. This signal is fed as a local signal for 1st mixer of RX path and for upconverter of TX path. When operating on lower band, the VCO signal is divided by 2 before feeding. This synthesizer is used for channel selection in all modes and both bands.

The UHF synthesizer consists of an external 2GHz VCO module with loop filter components and integrated PLL parts in TACO. Integrated charge pump circuit allows analog and digital operation modes. The VCO oscillation frequency is from 2009.1 MHz to 2125.53 MHz. The output frequency of the VCO module depends on the DC control voltage, which is controlled by the PLL circuit inside TACO.